Cal E−scale: Effects on Physics

- Top mass systematics from jets
- Inclusive jet cross section

From tower energies to Jets:

- E−scale of individual particles (e, mu, pions)
- Simulation has to reproduce data for particles
- Use MC and simulation to go from particles to jets

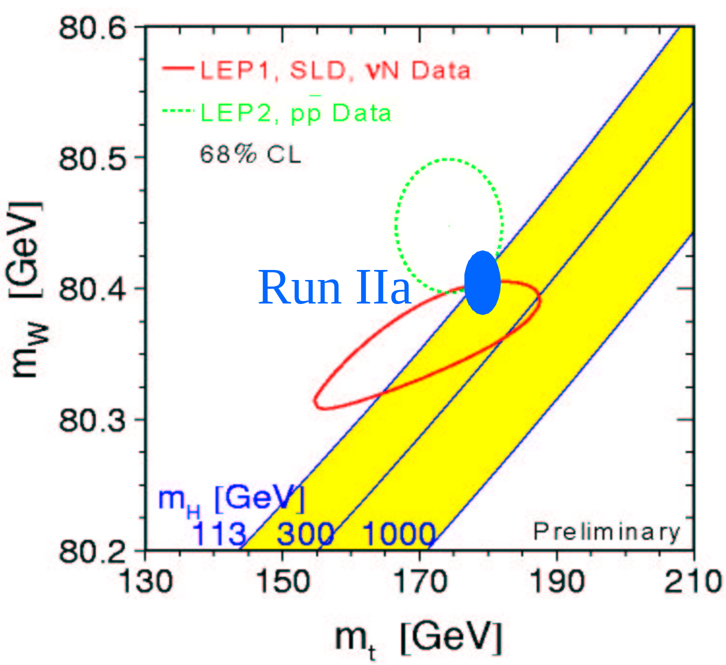
so both are essential:

- Correct tower energies
- Proper response in simulation

Mass measurement: monitoring the data

How important is to have a well calibrated calorimeter?
The top mass measurement is a very important contribution to testing the standard model at the Tevatron. Present status shows agreement between SM fits of data and direct measurements of MW and Mtop at the 2 σ level.

Electroweek precision measurements



Run II "projected" $\Delta M_t = \pm 3$ GeV

M(top) = 176.0 ± 4.2 (stat) ± 5.1 (syst) GeV

M(top) = 174.3± 5.1 GeV CDF+D0 comb.
M(W) = 80.450 ± 0.034 GeV LEP+TEV.

Run II TDR says that we will measure the mass with

$\Delta M(top) = \pm 3$ GeV

This would match a measurement of the W mass with a precision of

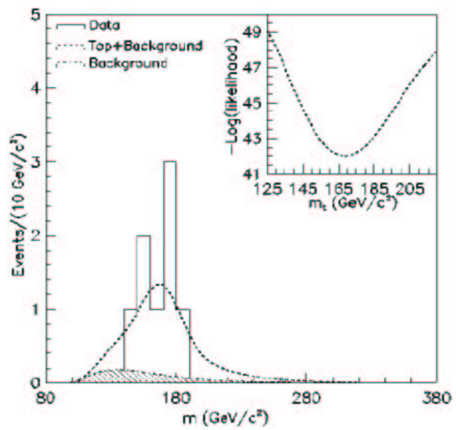
$\Delta M(W) = \pm 20$ MeV

I think this is ambitious!

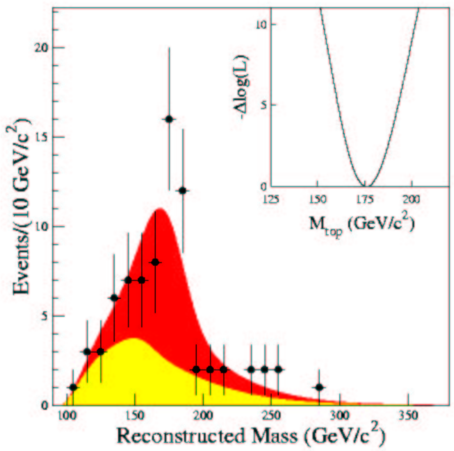
How can we improve the top mass?

Plan is to reduce the systematic error from 5.1 to 3.0 GeV

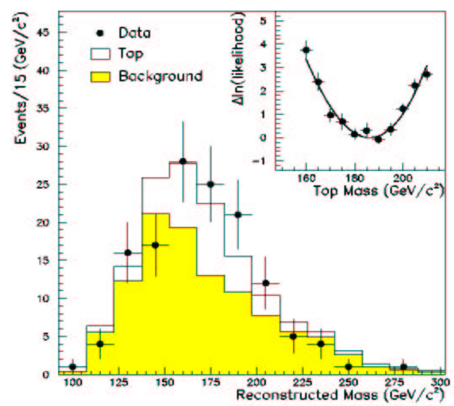
- We used three channels, major systematic error is from jets (>3.8 GeV)



Dilepton, Nev= 8(6.7)



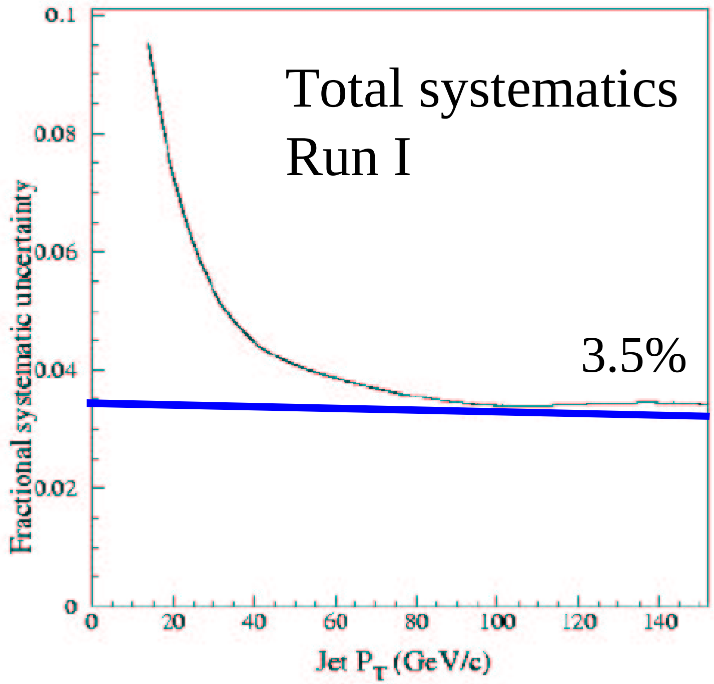
l+jets, Nev=76(40)

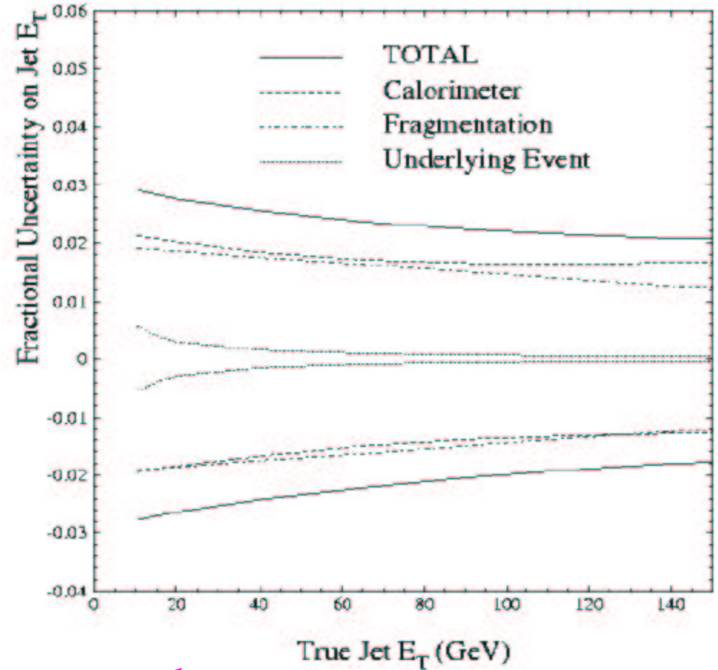


All−had, Nev=187(45)

Channel	dilepton	l+jets	all−had
Mass (GeV)	167.4 ±10.3±4.8	175.9±4.8±5.3	186.0 ±10.0±5.7
Systematic errors:			
Jet energy scale	3.8	4.4	5.0
ISR, FSR	2.7	2.6	1.8
Monte Carlo (gen,sim)	1.1	0.5	1.0
Background shape	0.3	1.3	1.7

Calorimeters systematics on top mass





Major systematics from jets (cone=0.4):

		Run II
Calorimeter stability	1%	5%
Absolute corr. (+UE) :	2.5%	same
Relative correction	0.2%, 4% in cracks	2%, 4% (.8−2.), 7% (>2.)
UEM (UE from mul. int.)	100 MeV/vertex	same
OOCC (exp to 55, >55)	6−1.4%	same

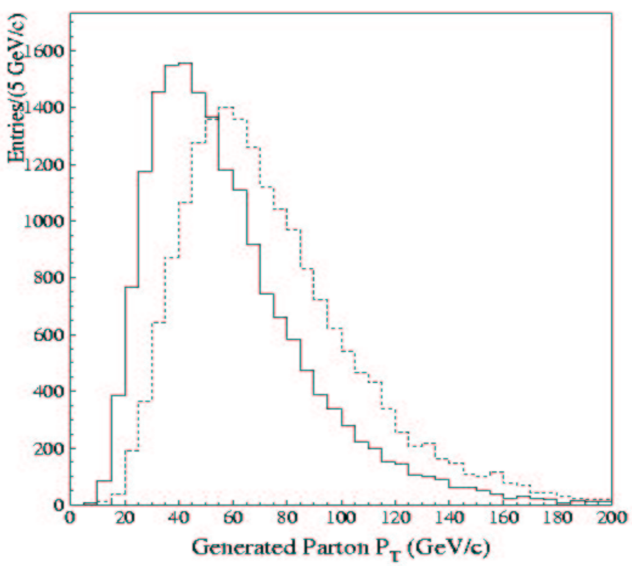
Run I jet systematics

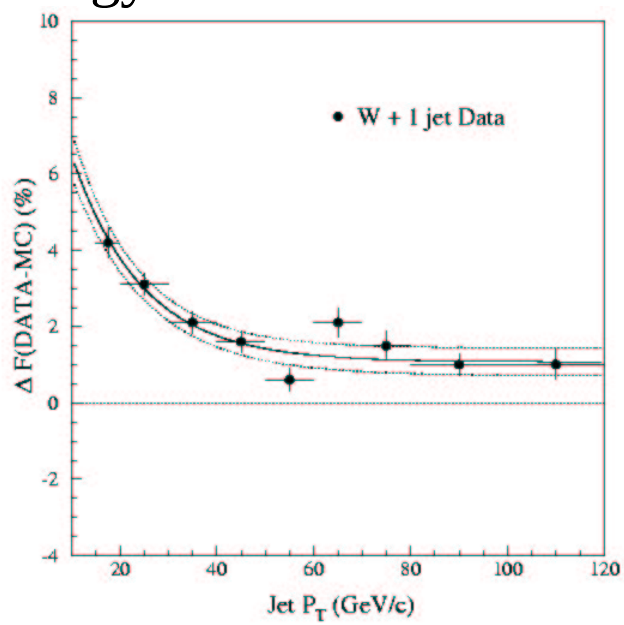
Notice big dependence on P_T(jet).
About ½ of the jets in top events are below 55 GeV, so large P_T dependence.

Used W+jets to determine out−of−cone systematics.
Can also use gam−jet events. Low statistics above 60 GeV.

Systematics on OOCC: compare data and MC for energy in an annulus .4−1.0

P_T(jet) for b and W jets





Run I jet systematics on top mass

- Calorimeter Stability : 1%

  1% → $\Delta M_t = 0.66\% \, M_t = 1.2$ GeV

- Absolute corrections : 2.5% ΔM_t=3.0 GeV

  This sets the E−SCALE, includes:

  calorimeter non linearity uncertainties

  cracks in central calorimeter, UE, etc.

➢ We need to keep the stability to at least 1%

➢ Absolute corrections: We need to reduce the uncertainties due to non−linearity and possibly cracks (more data)

➢ Will use additional data to reduce the systematics on the E−scale

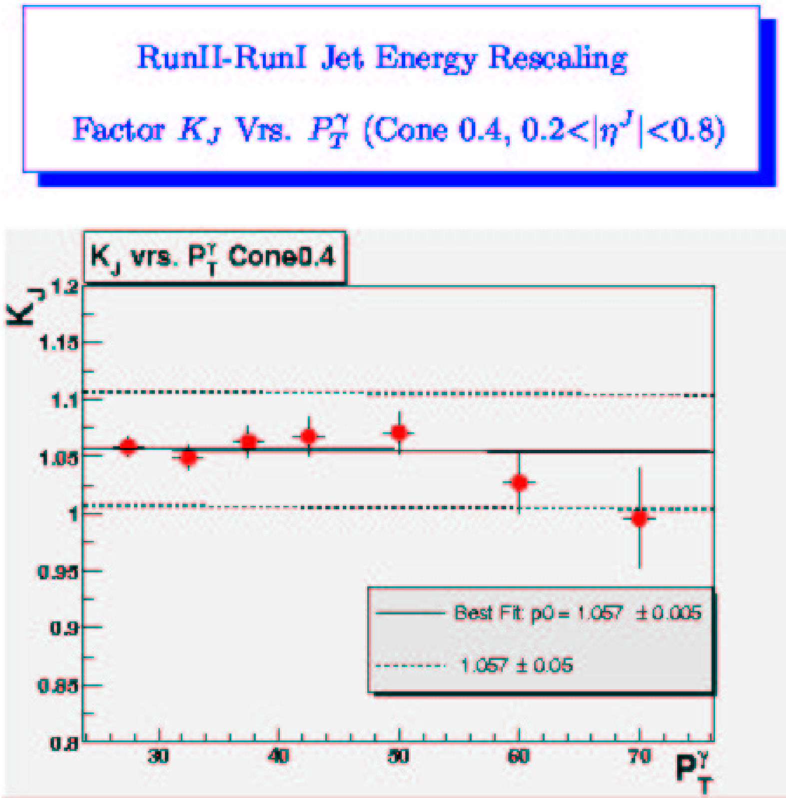
  Z → b−bar

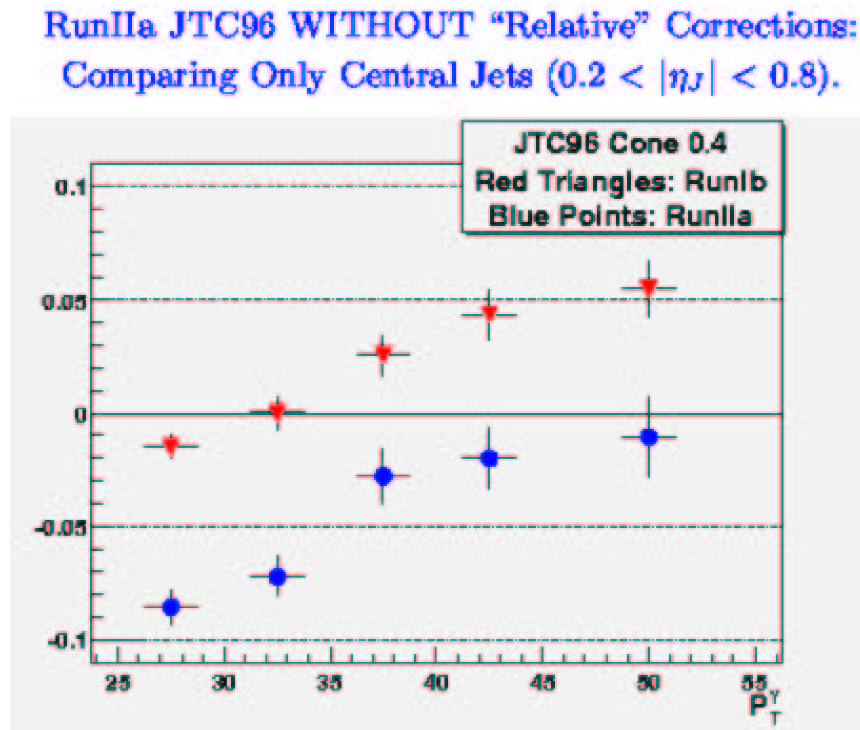
  gam−jet balance

  Z−jet balance

Run II jet systematics

5% uncertainty from raw jet comparison with Run I in gam−jet balance study.





Run I lepton+jets M(top) = 175.9 ±4.8±5.3 GeV

Run II (pretag only) M(top) = $171.2^{+14.4}_{-12.5}$ ±9.9 GeV

Relative jet corrections in data

Effect of recent finding of WHA shift of 10%, not seen in data

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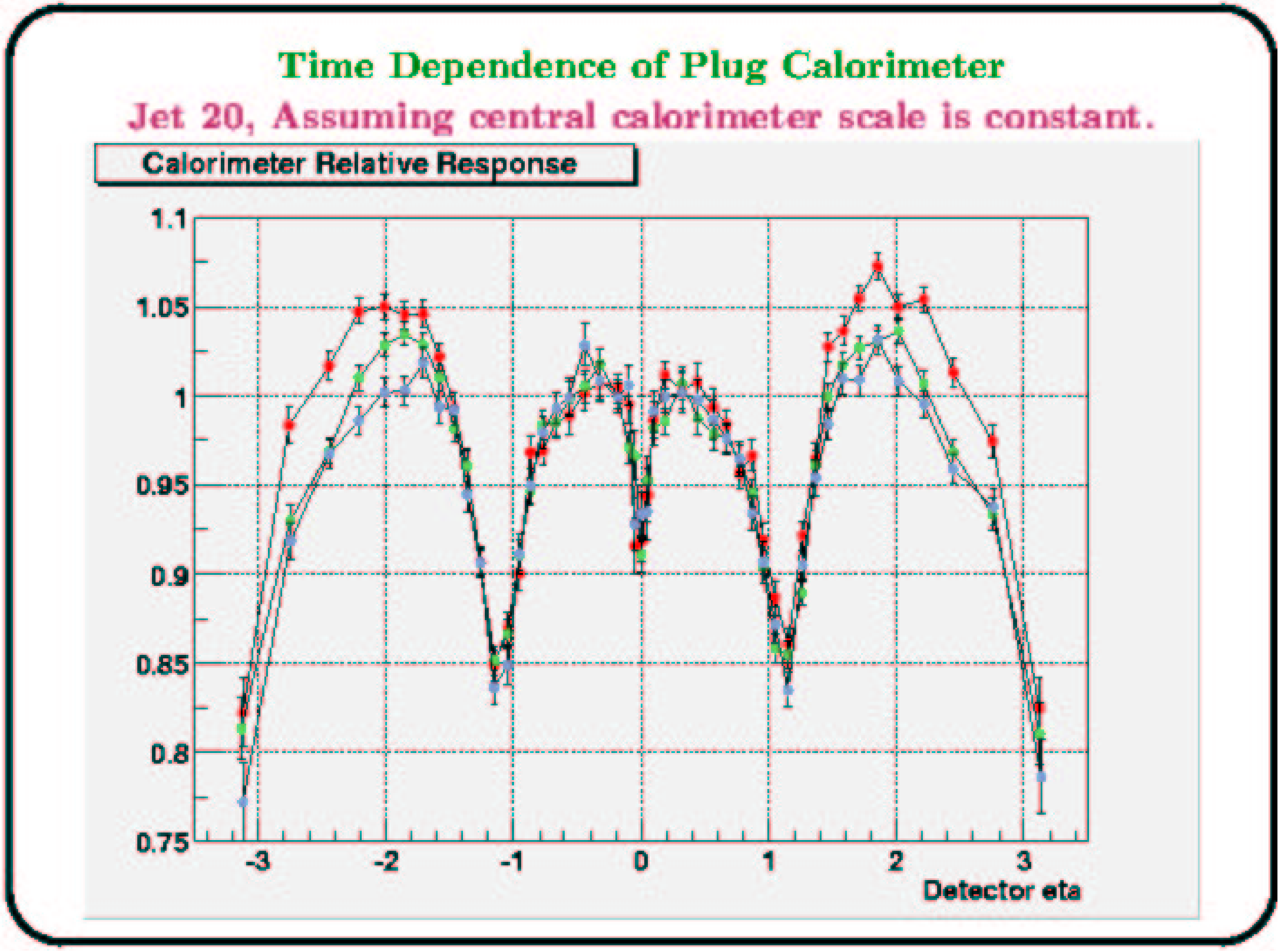
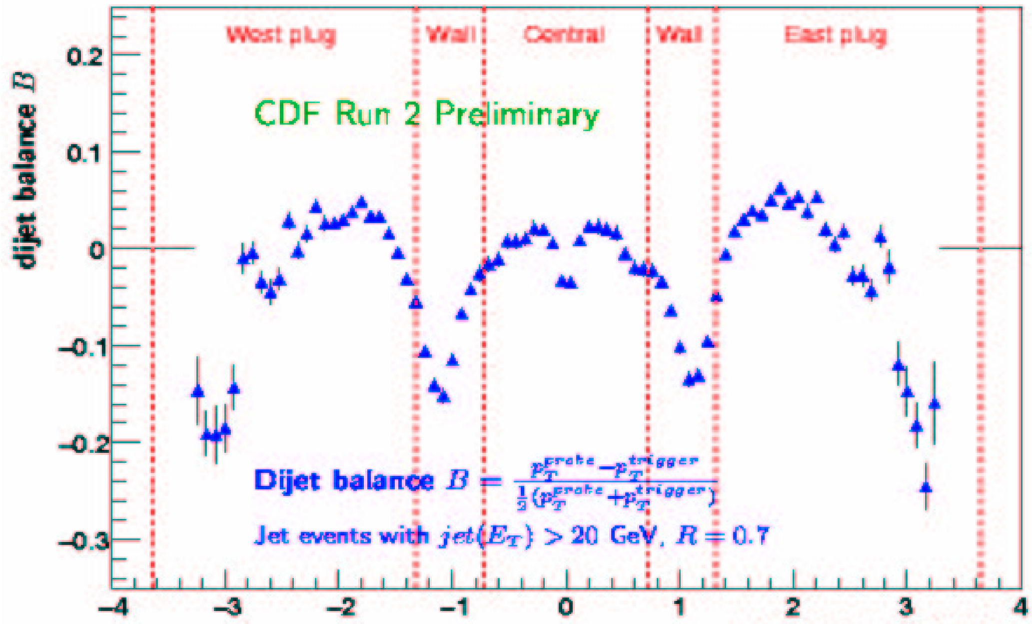
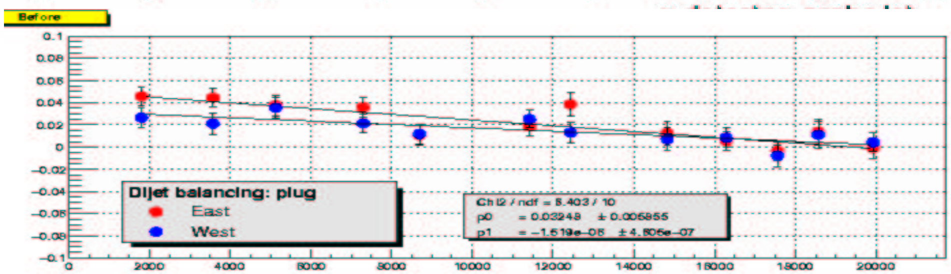
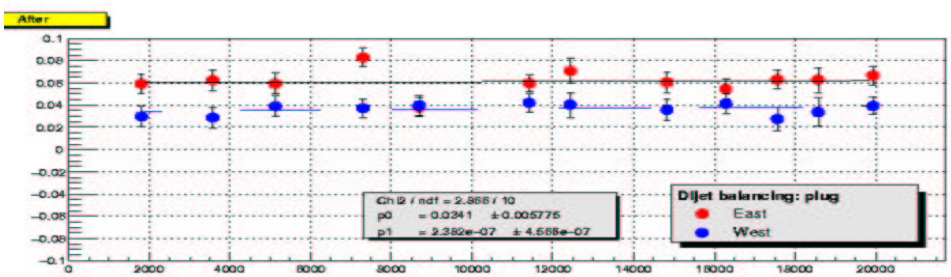


Correction for plug gain variations

- Plug E−scale studies, using di−jet balance (Currat, Lys, Galtieri)







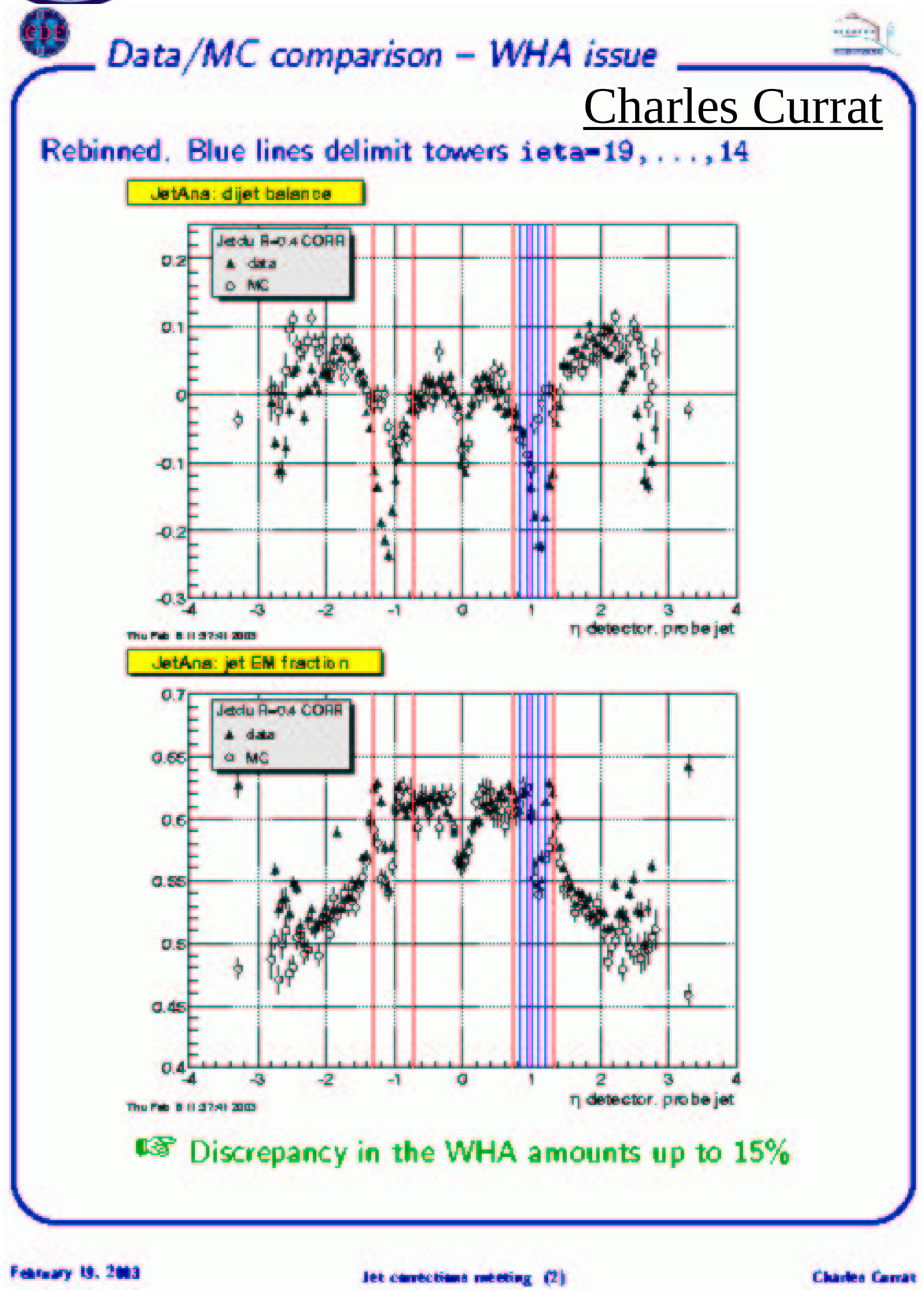
Data from Feb. 4/02 to June 02

Eta Detector

Eta >1.8
Use laser data to get time dependence.
Corrections flattens out the distributions.

Delivered luminosity

Data and MC comparison for R=0.4



Data has been corrected for PLUG calorimeter time dependent gains.

Note disagreement:

- Crack region (WHA)
- $|\eta| > 2.0$

Crack region:

- ➢ relative correction very different

EMF very different

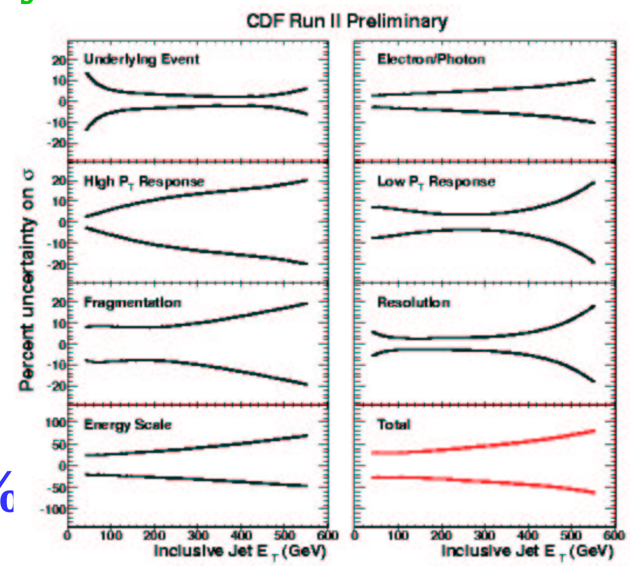
$|\eta|$ range	MC	data	Run I
0.0−0.1	2%	2%	2%
0.1−0.8	0.2%	0.2%	same
0.8−1.4	4%	15%	4%
1.4−2.0	4%	4%	0.2%
>2.0	7%	7%	4% crack

Jet Energy Scale and Jet cross section

Systematic Uncertainties

±20%

±100%

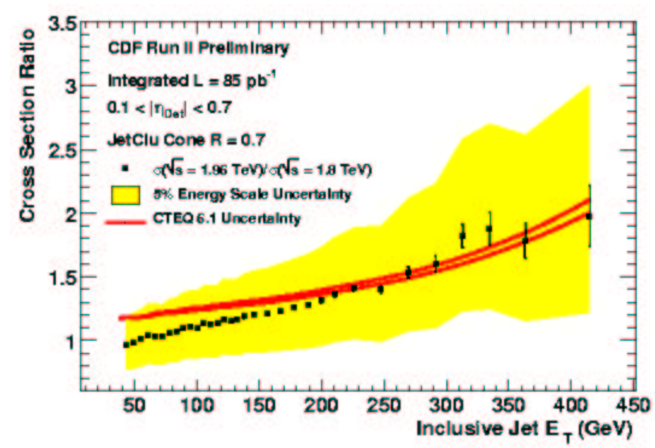


Ratio Cross Section Run II/RunI

3.0

2.0

1.0



- Tevatron: unique place to measure high x,Q^2 gluon distribution functions
- Limited by energy scale systematic
- Need better precision to test NNLO QCD/re−summed calculations
- Effect seen in all jet cross section measurements, *W+jets*, *Z+jets*
- 1% uncertainty in energy scale ? 5−7% in cross section

Yellow band size is unacceptable!!

Summary and Conclusions

It is urgent that we understand

- The 5% shift in raw jet energies
- The crack regions
- Final plug time dependent corrections

We have to retune the Monte Carlo using data with all the fixes we know at this time

Problems with Jet Corrections

DATA:

The 5% disagreement from gam−jet balance (central)

Cracks disagreement:

- WHA scale in data (10% off? Effect not seen in jet data)
- Geometry in MC

Plug: need to use time dependent gain corrections

Understand jets above eta=2 (data and MC)

SIMULATION:

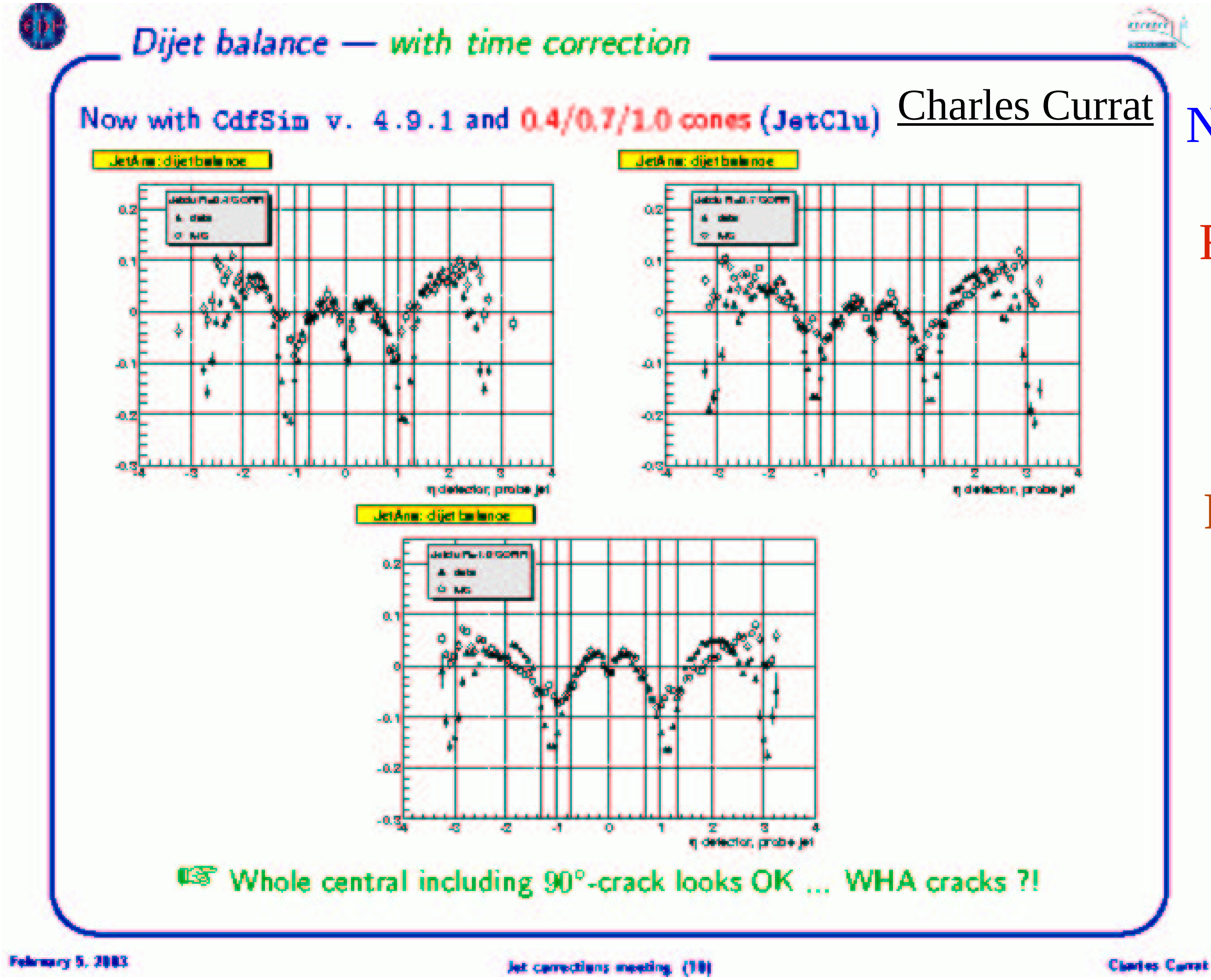
- Check isolated (central) pions in Minbias data (need CEM corrections)
- Retune simulation using new data (Matt&Mel) + get new minbias (both longitudinal and transverse tuning)
  This should take care of the 4% CHA fix not yet used in simulation
- Fix crack (geometry only?)

OTHERS:

- Plug disagreement above eta=2 to be investigated
- REDO ABSOLUTE CORRECTION!!!

Di−jet balance plug corrected data

Time dependent correction applied to plug jets (using tower constants)



Note disagreement:

For cone =0.4

- crack region
- $|\eta| > 2.0$

For cone =1.0

- crack region
- $|\eta| > 1.0$